UNSW AUSTRALIA

Course Outline

Semester 1 2015

Never Stand Still | Faculty of Engineering | School of Mechanical and Manufacturing Engineering

NAVL4140

Design of Yachts and High Speed Craft

Contents

Course Outline

NAVL4140 Design of Yachts and High Speed Craft

1. COURSE STAFF

Contact details and consultation times for course convener:

Mr David Lyons
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Tel (02) 9385 6120 or (0418) 208 370 (send SMS or leave voicemail if unattended)

Consultation concerning this course is available by email, by phone or in person. For an in-person appointment, please contact me by email first or see me in class.

Contact details and consultation times for additional lecturers and tutorial staff:

Mr Craig Boulton
Tel (02) 9882 3844
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Dr Rozetta Payne
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Email rozetta_payne@hotmail.com

2. COURSE DETAILS

Units of credit

This is a 6 unit-of-credit (UoC) course, and involves 6 hours per week (h/w) of face-to-face contact.

The UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work.”

For a standard 24 UoC in the semester, this means 600 hours, spread over an effective 15 weeks of the semester (thirteen weeks plus stuvac plus one effective exam week), or 40 hours per week, for an average student aiming for a credit grade. Various factors, such as your own ability, your target grade, etc., will influence the time needed in your case.

Some students spend much more than 40 h/w, but you should aim for not less than 40 h/w on coursework for 24 UoC.

This means that you should aim to spend not less than about 10 h/w on this course, i.e. an additional 4 h/w of your own time. This should be spent in making sure that you understand the lecture material, completing the set assignments, further reading about the course material, and revising and learning for the examination.

There is no parallel teaching in this course.

Summary of the course

Australia is currently doing well at designing yachts and high-speed craft. This course focusses on how these vessels are designed, the materials used, the analyses which are required, and the rules and regulations which are applicable.

Aims of the course

This course enables you to explore the design of high-speed craft from the viewpoint of the practising consultant looking at the rules embodied in the High Speed Craft Code 2000 and how they apply in practice. You are given practical insight into the analysis of the structure, and to the application of hydrodynamic principles to the prediction of resistance and performance.

The course also provides you with the terminology and tools unique to the design of yachts, most of which are now constructed in composites. You are also given the tools to analyse the sail and rig of the yacht, the fin and ballast requirements, the resistance and, hence, the performance of the yacht using a velocity-prediction program.

This course uses the ship terminology which you learned in NAVL3610, and builds on the hydrodynamic principles which you learned in NAVL3620. For those choosing a yacht or high-speed ferry for their design project in NAVL4120 and NAVL4130, this provides a good stepping stone for the final design iteration. The assignments also build on the report-writing skills which you commenced in ENGG1000.

Student learning outcomes

At the conclusion of this course, it is expected that you will be able to:

- Apply the HSC Code 2000 to the design of high-speed vessels and, in particular, the sections on buoyancy, stability and subdivision, operating compartment layout, and accommodation and escape measures, and analyse the vessel's structure in accordance with the rules of a classification society.
- Calculate the resistance and powering requirements of a range of high-speed vessels (including monohulls, catamarans and hydrofoils), and judge whether the craft is performing efficiently in relation to others.
- Decide the principal dimensions for the design of a new yacht to suit an owner's requirements, and be able to advise on the appropriate selection of materials for construction.
- Analyse the influence of rating rules and wind/sea conditions by way of a velocity-prediction program, and analyse the scantlings of the hull structure, the aerodynamics of the sails and rigging, and the hydrodynamics of the hull, keel and rudder.

Graduate attributes

UNSW's graduate attributes are shown at
https://my.unsw.edu.au/student/atoz/GraduateAttributes.html

UNSW aspires to develop graduates who are rigorous scholars, capable of leadership and professional practice in a global community. The university has, thus, articulated the following Graduate Attributes as desired learning outcomes for ALL UNSW students.

UNSW graduates will be

1. Scholars who are:
   - (a) understanding of their discipline in its interdisciplinary context ✓
   - (b) capable of independent and collaborative enquiry
   - (c) rigorous in their analysis, critique, and reflection
   - (d) able to apply their knowledge and skills to solving problems ✓
   - (e) ethical practitioners
   - (f) capable of effective communication ✓
   - (g) information literate ✓
   - (h) digitally literate

2. Leaders who are:
   - (a) enterprising, innovative and creative ✓
   - (b) capable of initiating as well as embracing change
   - (c) collaborative team workers ✓

3. Professionals who are:
   - (a) capable of independent, self-directed practice ✓
   - (b) capable of lifelong learning
   - (c) capable of operating within an agreed Code of Practice

4. Global Citizens who are:
   - (a) capable of applying their discipline in local, national and international contexts
   - (b) culturally aware and capable of respecting diversity and acting in socially just/responsible ways
   - (c) capable of environmental responsibility

   ✓ = Developed in this course

In this course, you will be encouraged to develop graduate attributes 1(a), 1(d), 1(f), 1(g), 2(a), and 2(c) by undertaking the selected activities and knowledge content. These attributes will be assessed within the prescribed assessment tasks, as shown in the assessment table on Page 6.

You will be supported in developing the above attributes through:
(i) the design of academic programs;
(ii) course planning and documentation;
(iii) learning and teaching strategies; and

(iv) assessment strategies.

3. RATIONALE FOR INCLUSION OF CONTENT AND TEACHING APPROACH

This course is included to give you the skills to generate designs of yachts and high-speed craft which will fulfil the owner's requirements and those of the regulatory authorities, and to be able to analyse the principal factors which contribute.

The content reflects the experience of the lecturers in drawing offices, in shipyards, and at sea on various vessels, and practical examples drawn from that experience are used throughout the lectures and tutorials.

Effective learning is supported when you are actively engaged in the learning process and by a climate of enquiry, and these are both an integral part of the lectures and tutorials.

You become more engaged in the learning process if you can see the relevance of your studies to professional, disciplinary and/or personal contexts, and the relevance is shown in the lectures and assignments by way of examples drawn from industry.

Dialogue is encouraged between you, others in the class and the lecturers. Diversity of experiences is acknowledged, as some students in each class have prior marine experience. Your experiences are drawn on to illustrate various aspects, and this helps to increase motivation and engagement.

It is expected that assignments will be marked and handed back in the week following submission. You will have feedback and discussion while fresh in your mind to improve the learning experience.

4. TEACHING STRATEGIES

Lectures in the course are designed to cover the terminology and core concepts and theories in the design of yachts and high-speed craft. They do not simply reiterate the texts, but build on the lecture topics using examples taken directly from industry to show how the theory is applied in practice and the details of when, where and how it should be applied.

The work in the yacht design assignments involves both self-directed work, in being creative in the design of your component, and teamwork, in integrating your component into the overall design.

Tutorials in Parts A and B are designed to provide you with feedback and discussion on the assignments as the design progresses, and to investigate problem areas in greater depth to ensure that you understand the application and can avoid making the same mistake again.

Tutorials in Part C are arranged on both a one-to-one basis with the lecturer, and group sessions with the lecturer, to assist in the analysis at each stage of the design process. Designs of components are discussed as they evolve, with a view to successful integration of the parts into the whole.

5. ASSESSMENT

General

You will be assessed by way of short assignments and examinations, both of which involve calculations and descriptive material.

The various parts of the course contribute towards the overall grade as follows:

	Part A		**Part B**	**Part C**
	HSC Design		**HSC Hydrodynamics**	**Yachts**
	C.J. Boulton		R.M. Payne	D.Lyons
h/w	1.5		1.5	3
Assignments	40%		40%	50%
Examination	60%		60%	50%
Total	100%		100%	100%
Scaled	50%		50%	
Part		100%		100%
Scaled		50%		50%
Overall			100%	

In order to pass the course, you must achieve an overall mark of at least 50%.

Assignments

The set assignments during the semester are shown on the following page. Assignments will be handed out in hard copy in class, and will be available on the Moodle website in case you miss the hand-out in class.

Part A High Speed Craft Design

No.	Assignment	Mark	Learning outcomes assessed	Graduate attributes assessed						Due Thu
1	(a) Field-of-vision requirements	5	Use of HSC Code	1(a)	1(d)	1(f)	1(g)			Week 3
	(b) General arrangement layout	10	Use of HSC Code	1(a)	1(d)	1(f)	1(g)			Week 5
	(c) Stability of multihull craft	10	Use of HSC Code	1(a)	1(d)	1(f)	1(g)			Week 5
2	Frame structure of a catamaran	50	Use of classification society rules	1(a)	1(d)		1(g)			Week 12
	Total	75								

Part B High Speed Craft Hydrodynamics

No.	Assignment	Mark	Learning outcomes assessed	Graduate attributes assessed						Due Thu
1	Dimensional analysis	10	Resistance, powering and efficiency	1(a)	1(d)					Week 4
2	Transport efficiency	10	Resistance, powering and efficiency	1(a)	1(d)		1(g)			Week 6
3	Resistance of planing craft	10	Resistance, powering and efficiency	1(a)	1(d)					Week 9
4	Hydrofoil lift, drag and cavitation	10	Resistance, powering and efficiency	1(a)	1(d)		1(g)			Week 11
	Total	40								

Part C Yachts

No.	Assignment	Mark	Learning outcomes assessed	Graduate attributes assessed						Due Tue
1	Design of rudder and stock	50	Analyse hydrodynamics	1(a)	1(d)	1(f)	1(g)			Week 13
2	Design of ballast lead and fin keel	50	Analyse hydrodynamics	1(a)	1(d)	1(f)	1(g)			Week 13
3	Lines plan of canoe body	50	Decide principal dimensions	1(a)	1(d)	1(f)		2(a)		Week 13
4	Drawing of deck arrangement	50	Decide principal dimensions	1(a)	1(d)	1(f)		2(a)		Week 13
5	Design of keel floors	50	Analyse structure	1(a)	1(d)	1(f)	1(g)			Week 13
6	Design of rudder bearings (&1)	50	Analyse structure	1(a)	1(d)	1(f)	1(g)		2(c)	Week 13
7	Design of hull shell laminate (&3)	50	Analyse structure	1(a)	1(d)	1(f)	1(g)		2(c)	Week 13
8	Design of deck laminate (&4)	50	Analyse structure	1(a)	1(d)	1(f)	1(g)		2(c)	Week 13
9	Design of mast section	50	Analyse mast and rigging	1(a)	1(d)	1(f)	1(g)			Week 13
10	Drawing of interior arrang't (&3, 4)	50	Decide principal dimensions	1(a)	1(d)	1(f)		2(a)	2(c)	Week 13
11	Drawing of sail plan and rig	50	Decide principal dimensions	1(a)	1(d)	1(f)				Week 13
12	Marketing brochure for the design	50	Analyse results	1(a)	1(d)	1(f)	1(g)			Week 13

& = Liaise with Assignment No.

Part C

Assignments in Part C will be given out in Week 6, and each is a part of a team project to design a 12 m yacht. You will be expected to undertake one part of the project (i.e. one assignment).

It is expected that each assignment will take about 16 h to complete, including background reading, calculations, drawing (sketch or CAD), and a written overview of about 200 words. These assignments give a practical application of the design methodology, and further practice in written communication skills.

Presentation

A standard specification is available from the School office to aid presentation of your assignments (in all courses). All submissions should have a standard School cover sheet. All submissions are expected to be neat, and clearly set out. All calculations should be shown as, in the event of incorrect answers, marks are awarded for method and understanding.

The preferred set-out of any numerical calculation is similar to the following:

$A_{bow} = 0.0035AmfV$	(Equation in symbols)
$= 0.0035 \times 480 \times 0.95 \times 1.0 \times 18.00$	(Numbers substituted)
$= 28.7\ m^2$	(Answer with units)

Submission

Assignments in Parts A and B are due on the scheduled day of the class in the week nominated below. Assignments should be submitted direct to the lecturer in class, rather than via the assignment boxes at the School office.

Assignments in Part C are due for submission to the lecturer at the start of the class in Week 13 for review and discussion in class, and subsequent assessment.

Late submission of assignments attracts a penalty of ten percent per *day*, unless prior dispensation has been given; i.e. see the lecturer before the due date to avoid penalty. An extension may only be granted in exceptional circumstances. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor ***before the due date***. Special consideration for assessment tasks of 20% or greater must be processed through https://student.unsw.edu.au/special-consideration.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Criteria

The following criteria will be used to grade assignments:

For reports:

- Identification of key facts and the integration of those facts in a logical development.
- Clarity of communication—this includes development of a clear and orderly structure and the highlighting of core arguments.
- Sentences in clear and plain English—this includes correct grammar, spelling and punctuation.
- Correct referencing in accordance with the prescribed citation and style guide.

For numerical calculations:

- Accuracy of numerical answers.
- All working shown (see *Presentation* above).
- Use of diagrams, where appropriate, to support or illustrate the calculations.
- Use of graphs, were appropriate, to support or illustrate the calculations.
- Use of tables, where appropriate, to support or shorten the calculations.
- Neatness.

Examinations

There will be two two-hour examinations at the end of the semester. Paper 1 will cover all material in both Parts A and B for the whole semester, and Paper 2 will cover all material in Part C for the whole semester.

You will need to provide your own calculator, of a make and model approved by UNSW, for the examinations. The list of approved calculators is shown at https://student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an “Approved” sticker for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an “Approved” sticker will not be allowed into the examination room.

Special Consideration and Supplementary Assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see *Administrative Matters for All Courses*, available on the School website.

6. ACADEMIC HONESTY AND PLAGIARISM

Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a booklet which provides essential information for avoiding plagiarism: https://my.unsw.edu.au/student/academiclife/Plagiarism.pdf

There is a range of resources to support students to avoid plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one. Information is available on the dedicated website Plagiarism and Academic Integrity website: http://www.lc.unsw.edu.au/plagiarism/index.html

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in a honours thesis) even suspension from the university. The Student Misconduct Procedures are available here: http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is presented in a School handout, *Administrative Matters for All Courses*, available on the School website.

7. COURSE SCHEDULE

The lectures and tutorials in this course are given as follows:

Part A HSC Design Friday 0900–1200 CE101

All lectures in this part are given by Mr Craig Boulton.

Week	Topic
2	Introduction, the HSC Code, g_{coll}, accommodation and escape measures, operating compartment layout

4	Accommodation design, intact and damaged stability, extent of damage, criteria
6	Stability, lifesaving, fire safety, structure and global loads
8	Structure, DNV HSLC rules, LR SSC rules, and NSCV Category F rules
10	Structural design of a web frame, seakeeping
12	Wake wash, propulsion

Part B HSC Hydrodynamics Friday 1300–1600 CE101

All lectures in this part are given by Dr Rozetta Payne.

Week	Topic
2	Introduction and dimensional analysis
4	Transport efficiency and sustention
6	Planing vessel resistance prediction (1)
8	Planing vessel resistance prediction (2)
10	Analysis of hydrofoil lift, drag and cavitation
12	High-performance craft (hydrofoils, ACVs SES, etc.)
13	Revision and exam details tutorial for Parts A and B

Part C Yachts (a) Friday 0900–1200 CE101
and
(b) Friday 1300–1600 CE101

All lectures in this part are given by Mr David Lyons.

Week	Topic
1	(a) Introduction, course outline, resistance (b) Yacht hydrodynamics (1): resistance upright and heeled, unappended and appended
3	(a) Yacht hydrodynamics (2): appendage design, seakeeping/added resistance, resistance “budget” (b) Yacht aerodynamics (1): sail plan design
5	(a) Yacht aerodynamics (2): rig design (b) Construction materials (1): composites
7	(a) Construction materials (2): timber, aluminium, steel (b) Construction materials (3): costs, gyradius, design of fittings
9	(a) Stability: intact static and dynamic (b) Rules and regulations (1): Structural rules — ABS Yacht Guide, ISO draft standards
11	(a) Rules and regulations (2): Rating and handicap rules — IMS, IRC, Volvo ocean rule (b)Velocity prediction programs, tank testing, CFD codes
13	Revision and exam details tutorial, submission and review of design assignments

8. RESOURCES FOR STUDENTS

Textbooks

Part A

International Maritime Organisation (2001), International Code of Safety for High-speed Craft 2000, IMO, London.

This is available in the UNSW Library, and for download from the Moodle website.

Part B

Doctors, L.J. (1985), Hydrodynamics of High-speed Small Craft, University of Michigan, Department of Naval Architecture and Marine Engineering, Report 292, Ann Arbor.

This is available in the UNSW Library, and for download from the Moodle website.

Part C

Larsson, L. and Eliasson, R.E. (2007), *Principles of Yacht Design*, 5th Ed., Adlard Coles Nautical, London is recommended.

The 3rd Edition is available in the UNSW Library.

Suggested additional readings

Parts A and B

Journal *Fast Ferry International*.

Papers from Fast Sea Transportation (FAST) conferences.

Papers from Fast Ferry International (FFI) conferences.

These are available in the UNSW Library. All are useful as additional reading material.

Part C

Claughton, R.E., Wellicome, J.F. and Shenoi, A. (Eds), *Sailing Yacht Design: Theory* (v.1) *and Practice* (v.2), Longman, London.

Marchaj, C.A. (1985), *Sailing Theory and Practic*e, Dodd Mead and Co., New York.

Marchaj, C.A. (1988), *Aero-hydrodynamics of Sailing*, Adlard Coles, London.

Skene, N.L. and Kinney, F.S. (1981), *Skene's Elements of Yacht Design*, 8th Ed, Dodd Mead & Co., New York.

All of these are available in the UNSW Library and are useful as additional reading material.

Papers from SNAME's annual Chesapeake Sailing Yacht Symposia (not available in the UNSW Library) are also useful reading material if you can lay your hands on them.

Additional materials provided in Moodle

This course has a website on Moodle which includes:

- copies of assignments (as they are issued, in case you missed the hand-out in class);
- previous examination papers in this course from 2010 onwards (not for Part C);
- answers to the numerical questions in examination papers from 2010 onwards; (not for Part C) and
- a discussion forum.

The discussion forum is intended for you to use with other students enrolled in this course. The course convenor will occasionally look at the forum, monitor the language used and take note of any frequently-asked questions, but will not respond to questions on the forum. If you want help from the convenor then direct contact is preferred.

Recommended Internet sites

Parts A and B

Principal particulars and design details of many different types of vessels are available on the Internet. You might like to try the following:

Austal Ships	www.austal.com
Incat Crowther Design	www.incatcrowther.com
One2three Naval Architects	www.one2three.com.au

or a general site (containing links to many other sites) such as

AIMEX	www.aimex.asn.au

Part C

There are many websites giving lectures, papers and data on yachts and yacht design. Try searching for yachts, or "yacht design" (including the quote marks), for example, with your favourite search engine (or, better, a meta-search engine such as Dogpile at www.dogpile .com).

You might like to try the following:

Beneteau	www.beneteau.com
McConaghy	www.mcconaghyboats.com

Gurit Composites	www.gurit.com
Reichel-Pugh Yacht Design	www.reichel-pugh.com
Farr Yacht Design	www.farrdesign.com

or, for news of what's happening in the yacht-racing world:

Sailing World	http://www.news.sail-world.com/

Other useful websites (for all parts) will be advised in class.

Other Resources

If you wish to explore any of the lecture topics in more depth, then other resources are available and assistance may be obtained from the UNSW Library.

One starting point for assistance is: www.library.unsw.edu.au/servicesfor/index.html

9. COURSE EVALUATION AND DEVELOPMENT

Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) process, informal discussion in the final tutorial class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include further documentation of the assignments, hands-on instruction in MultiFrame and provision of PowerPoint notes for Part A, the addition of more assignments to suit the increasing number of students in Part C, and the provision of notes and assignments on Moodle.

10. ADMINISTRATIVE MATTERS

You are expected to have read and be familiar with *Administrative Matters for All Courses*, available on the School website. This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

D. Lyons
20 February 2015